

Dec 30 04

RESPONSE TO DETAILED ACTION OF OFFICE ACTION

The following response follows the Detailed Action in order.

1. Claims 1 and 15 were rejected as "being anticipated by Mendenhall." Mendenhall et al are really very different than Christopher (see preceding discussion of alternate filings) and has a different relation to a satellite communication system.

The Mendenhall filing on an optical tracker is a key subset of a satellite communication system. It does not, however, address the viability of a satellite communication system with the necessary considerations of geographic location, atmospheric attenuation, satellite orbits, and frequency selection.

The Christopher filing [and provisional filing of Nov. 7, 2000] assures the viability of the satellite communication system by noting the key relations between location, satellite orbits, and atmospheric attenuation for optimum frequency selection. A good choice of orbits (e.g., Molniya combined with antipodal Geostationary satellites) allowed optimum millimeter wave frequency choices as shown in Att. 3 (Ka conference, Cleveland, June 2000).

The good choice of orbits also implied reasonable infrared (10 micron) Trans-Atlantic links between Bangor Maine and Oslo Norway (Christopher, SPIE, Jan 2001). *The corresponding optical links (near 1 micron) were not reasonable*, unlike the PTO assertion that optical and IR links are equivalent.

2. Claims 2-3, 7, 9-10, 14, 16-17, 21, 23-24, 28-29, 36-39, 46-51 were rejected "as being unpatentable over Mendenhall et al – in view of Badesha et al."

Again, Mendenhall's fine optical tracker is a key component of a satellite communication system, *but is only a component*. (see above). Perhaps, more seriously, the PTO assumes that infrared is the same as optical communication. This assertion has never been assumed by communications researchers (e.g., Chu and Hogg, BSTJ May-June 1968) who carefully sought out the key differences in communication performance as a function of wavelength. This topic continues as a key research area as Frank Hanson studies the different communication capabilities of 1, 3, and 10 micron communication (SPIE Optical Engineering, Nov. 2000) and attempts to apply each of them optimally to different areas around the world.

The Badesha filing is an entirely different case. (Please see prior comments on alternate filings). The Surjit S. Badesha, et al, Pub. No. US 2002/0167702 A1

Optical Communication System Using a High Altitude Tethered Balloon
is important for other reasons.

The Badesha filing may have important uses, as returning high data rates from space probes via tethered high altitude platforms to a central receiving site. It could be important for sites such as the NASA White Sands site when carrier frequencies are raised to the upper millimeter wave region or if laser frequencies are needed for space-ground communication. It may have important uses also at NASA in Greenbelt MD where the high altitude balloon will allow the system to avoid the intense atmospheric attenuation of the northeastern U.S.

The PTO may wish to check the dates on the Badesha filing. The Jul 3 2002 and Jan 9 2001 filing dates do not appear to precede the Nov. 7 2000 Provisional Filing date on the Christopher filing.

The Badesha filing does not, however, meet the needs of most satellite communications users. By serving a single ground site, it has avoided the atmospheric losses that most users need to consider before choosing a frequency or a satellite system.

Atmospheric losses have been recognized to be the central issue for decades (see the attached preface). Christopher has addressed this issue directly by studying atmospheric losses as a function of frequency, and by studying satellites that would relieve the normal massive atmospheric attenuation at frequencies > 30 GHz.

The Christopher filing is concerned with a preponderant number of satellite-ground link users, and *should not be compared* with the Badesha filing:

A typically useful satellite system (e.g., Christopher, 2001) would:

- Serve a large number of ground terminals, as thousands or hundreds of thousands.

Examples would include a direct satellite to ground TV system.

- The homeowners would find the 'last mile' interconnect costs prohibitive for the Badesha concept.

Another useful satellite system will have military uses in the near future (Martin Shelley, Ka Conference, Vicenza, Italy, Oct. 2, 2004).

- The satellite-ground system will service thousands of military vehicles.

--Low profile antennas have been developed for HumVees, specifically for these demands.

-A larger context for military satellite systems has been addressed at Milcom 2004.

--Every small user in the service would have a link to a Global Information Grid (GIG). This would usually mean that every small (DoD) user would have a link to a military satellite. The Wideband Gapfiller (Dec 2005) is envisioned to fill this kind of need.

The Christopher filing is intended to address the needs of massive numbers of ground users, and to deliver the much higher data rates than can be found for conventional systems at frequencies <30 GHz.

The Badesha filing will not, and should not, be considered for these large scale satellite-ground communication links.

The PTO goes on to note that Badesha addresses the need for site diversity. *It leaves unstated how this would be obvious* and how the diversity should occur: Should it occur with spacing defined by the ITU (as hundreds of km) or by the Furuham rain correlation function (as 5-10 km; Christopher, Ka 2003), or should spacing be chosen by a Soviet cloud autocorrelation function?

Regarding Claims 2-3 and 9-10, we should also not that, *unlike the PTO assertion that Badesha addresses clouds, rain, and fog, the Badesha filing makes only a bare*

recognition of these serious areas. The real intent of the Badesha filing is to avoid the atmospheric problems, and it does that very well.

Regarding Claims 7 and 14, the PTO again asserts that Badesha has addressed atmospheric problems. This bare recognition of atmospheric problems has done nothing to show the large advantages of IR communication near 10 microns wavelength over 1 micron communication, and Badesha leaves this unaddressed. The PTO further mentions that it would be obvious to use a probability density function to reduce the distance of the signal in the atmosphere. *However, the probability density function method and actual results did not exist until the June 2000 Ka Conference* (Christopher, Att. 3).

Regarding Claims 16-17 and 23-24, Badesha leaves the serious questions of atmospheric attenuation essentially unaddressed. *Cloud attenuation maps were not available until the SPIE conference of Jan 2001* (Christopher, Att. 4). *These cloud attenuation maps also showed the sharp advantages of 10 micron communication over conventional laser* (near 1 micron) communication plans.

Regarding Claims 21 and 28, Badesha and others were not in a position to use conceptual probability density functions of elevation or actual pdf's, because they did not exist until June 2000 (Christopher, Att. 3).

Regarding Claims 29 and 39, the PTO again misapplies Mendenhall by identifying his optical discussion with infrared communication. It again refers to the slight mention of atmospheric problems by Badesha as showing the need to find good locations. This just

begs the question with a search for good locations like Mt. Lemmon and Death Valley. *However*, the real need for satellite communications is to choose locations that are near metro areas that may have mediocre atmospheric conditions. Then, serious questions of atmospheric attenuation, choice of orbits, and choice of frequencies may be addressed. The PTO also refers to Badesha's brief mention of the need for diversity. Again, this leaves more questions than answers. Should the diversity occur with spacing defined by the Furuham rain correlation function (Christopher, Ka 2003), or should it choose spacing with a Soviet cloud autocorrelation function?

Regarding Claims 36-38, and 46-48, the question again is not an optimal location, but taking a mediocre but useable location and making it work. (See Claims 16-17, above).

Regarding Claims 49-51, the PTO again misapplies Mendenhall to infrared communication. The PTO further states the obviousness of choosing an optimal location (see the Reference to claims 16-17 above). These cloud attenuation maps were not available until Jan 2001 (Christopher, Att. 4).

Regarding Claims 4, 11, 18 and 25, reference can be made again to Claims 16-17 above. The cloud attenuation maps were not available until Jan 2001, and good locations were not only not obvious, it was not known how to conveniently treat them, or to get actual cloud attenuation results.

3. Claims 5, 12, 19, 26, 30-35 and 40-45 were rejected as being unpatentable over Mendenhall, in view of Badesha, and further in view of Pfeiffer.

The essential complementary nature of Mendenhall has been discussed above, and how it does not relate in significant ways to the choice of infrared communication systems.

Badesha was shown above to be promising for satellite to single ground terminal.

Badesha was shown to be not especially useful for satellite- large aggregates of ground receivers. Badesha also had fundamental questions about the dates of filing and relations to Christopher's filing dates (Nov. 7 2000; Nov. 7, 2001).

The PTO then raises the key filing by Pfeiffer et al. This is truly a valuable filing on missile detection. This is a passive infrared missile detection problem, not a satellite-ground communication problem. The infrared detection is mentioned because it is the dominant black body radiation of a hot missile. There are very few choices for passively detecting a missile other than infrared detection. This is unlike satellite communications, where relatively low power coherent transmitters must be used and a wide choice of frequencies is available and frequencies should be carefully chosen.

There are many frequency choices for satellite communication. As the Christopher filing (and Attachments) shows, a wide range of choices are available from low frequencies, through millimeter wave frequencies, to a range of infrared frequencies. Best frequencies may be found as a function of location and orbits, as shown in the filing.

The Pfeiffer filing, being in a different field, also does not have to address the choice of satellite orbits suitable for satellite communication.

The PTO goes further to misapply the Pfeiffer example of a cumulative distribution of background clutter, and say that it "is analog to the signal degradation of the satellite communication system by water content in the clouds." *There is no analogy*, except that a cumulative distribution function was used in entirely dissimilar cases.

4. The Claims 6, 13, 20, and 27 were rejected as being unpatentable (Mendenhall, Badesha, and Chu). The inapplicability of Mendenhall and Badesha are discussed above.

The PTO may wish to check its records on Chu. The inventor (Christopher, 2001) sent Chu and Hogg to the PTO in 2001. Indeed, the copy of Chu and Hogg in the November 2004 mailing still bears Christopher's library stamp.

Chu and Hogg were vital in Christopher's Nov 2001 filing, and in SPIE 2001 (Att. 4). It was not the only thing that was vital however: *the SPIE paper stated upfront that Barbaliscia's cloud attenuation functions were needed in combination with Chu to find water content of clouds.* The water content of clouds was not explicitly shown until then. Chu and Hogg then allowed attenuation at infrared and optical frequencies to be found. To reiterate, *the water content of clouds was a research topic, and not a handbook exercise* to be done by anyone familiar with the field.

5. Claims 8 and 22 were rejected as being anticipated by Mendenhall, in view of Ross et al.

Again, PTO misapplies Mendenhall to an infrared system. Communication analysts do not, *and cannot*, treat optical communications and infrared communication as equivalent. Entirely different attenuation conditions and results apply to comparisons of optical/infrared communication links. Please see above (e.g., Sec. 2) for the relations between Mendenhall/Christopher 2001.

The PTO then discusses the important filing by Ross. Intersatellite links (ISL's), by NASA nomenclature, have been very important for linking NASA Tracking and Data Relay System Satellites (TDRS) to low altitude (and even altitudes higher than geosynchronous orbits) satellites. Christopher was deeply involved in predicting properties of these links in the 1987-1999 period for NASA. Very important ISL's included TDRS- Landsat 4,5 and the followup Earth Observation series (EOS). Christopher also analyzed the properties of TDRS- Molniya orbits from '90 to '96. Thousands of different kinds of orbits can be analyzed for ISL properties. (A minor correction to the PTO Section 5: Molniya is not a low earth orbit. See Att. 3, Christopher, June 2001 for some of its properties).

The properties of ISL's are an entirely different matter from desirable properties of satellite-ground links. Satellite communication scientists and engineers must analyze a wide variety of orbits to see suitability for satellite communication (a sample shown in

Christopher, Att. 3, June 2000). Unlike the PTO assertion, *no orbits were obvious* until the comprehensive elevation angle statistics were developed. Again, June 2000 was the first time comprehensive *elevation statistics for all time* were shown.

This section can be concluded by noting that further useful references to satellite communications and their desirable properties are available. Christopher's 2 volume set on Millimeter Wave Satellite Communication is available (Vol. 1 on Satellite Orbits; and Vol. 2 on Propagation; Leesburg, VA 2000).